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The Role of Biology in Conservation Education*

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The theme which seems to unite most discussions of the conservation of renewable natural resources is that of biology.[1] The basis of forest conservation is biology. Our most effective methods of retaining soil and water involve biological beings, the plants. The fisheries are biological problems. Man himself is a biological entity. The relationship between populations, including man, and their food supplies is fundamentally biological in nature. Almost without exception, it is biology to which we turn for answers to our conservation questions.

I would have no one misunderstand me in regard to primary education. The problem of learning to read and to interpret is basic and should be advanced by every means available. People must be literate before they can be led to a reasonable understanding of their place in the universe. The general education of our citizens is in reality a problem in biology since man is a biological being, and this basic education presents other biological questions. For instance, cultural and moral improvement in a nation is dependent upon the economic and nutritional well-being of the individuals in the population. These are biological problems in the fields of education and sociology.

One of the deficiencies frequently found in formal education is the failure to include sufficient biology. In most countries it is possible to finish not only the elementary and the secondary years but also college or university training *without any science*. The time has come when biology must be included in all college curricula. I say this not for personal reasons, but because I am convinced that the survival of our civilization, and perhaps of man himself, is absolutely dependent upon our under-

* Prepared for and presented at the Inter-American Conference on Conservation of Renewable Natural Resources, Denver, Colorado, September 7–20, 1948.

[1] Biology, i.e., both botany and zoology.

standing of our relationship to all living things. The hour is too late for personal feelings or whims to be the deciding factor in regard to this phase of our college curricula.

I would also insist that our high school students must have some understanding of the biological world in which they live. This is all the more imperative since few of our young people receive college training. I would go even further and introduce certain phases of biology *beyond* human physiology into elementary education. According to Blose (1), there are many people, some very intelligent, who never receive the equivalent of high school training.[2] It is probably true that at this elementary level (and perhaps at all levels) new methods and new materials will have to be devised, but this can and must be done.

At this point, it should be emphasized that biology can serve as well as any science in teaching the relation between cause and effect, a most important item in education. As yet, too many decisions, even involving conservation, are made by our citizens and officials on the basis of prejudice and emotion. A child cannot learn too early that the individual is responsible for his actions, and that these invariably lead to good or bad reactions or effects.

Again, biology can serve better than any other subject, not only in orienting man in the universe, but also in teaching the fundamental unity and balance in that universe. Too often, actually in the majority of cases, each subject (including biology) is taught as an independent unit. Biology, properly taught, makes use of chemistry, physics, mathematics, geography, and other disciplines.

[2] It should be noted that of the children starting the first grade in the United States, approximately 85% finish the 8th grade, 45% receive high school diplomas and less than 5% receive a college degree.

One of the common failures in education is represented by the fact that few students ever visualize the universe as an integrated whole, and we must not forget that this concept is very important to an understanding of conservation.

There is still another phase of education in which there must be introduced material for facilitating an understanding of the biological resources of the local community and even of the world. I refer to adult education. The decisions regarding conservation are in the hands of adults, and, by whatever means they can be reached: By radio, by press, by classes and conferences, by demonstrations, it must be urgently impressed upon them that their economy and culture and the future of their children are closely interrelated with the biological well-being of their community.

It may sound as if I can only find fault with education in general for its failure to include enough biology to insure that our citizens understand and appreciate their environment. The fault lies in part, perhaps equally, with biologists. Like all people, biologists have their prejudices and short-comings. All too few of them appreciate the fundamental relationships between their science and our civilization; often then cannot even bridge the gap between their specialty and some other phase of biology. Some biology teachers who do have this appreciation lack the feeling of responsibility for inculcating a sound understanding of the cosmic relationship in their students. Again, the biologist frequently fails to use proper methods and materials for his particular audience. And traditionally, *much* beginning biology is taught as a laboratory science without reference to the field. And there are still colleges in America where biology is taught dogmatically,

without laboratory equipment and materials or even a single field trip!

It is also imperative that our biologists, if they become specialists, have in addition a deep understanding of the relationship of their field to biology in general and even to the world at large. They must relate their subject to the other disciplines and help the students visualize their environment as a unified whole consisting of many interrelated facets.

I have already pointed out that biology can make as large a contribution as any discipline toward the conservation of our natural resources. Before it can perform its maximum service, however, some of the difficulties currently present in the field of biology must be overcome. On a highly competitive market there must be found zealous teachers not only with sound biological training but also with a broad understanding of ecological relationships. The word "zealous" is used purposely, for we need teachers so thoroughly imbued with the importance of their work that not only will they make the almost inevitable financial sacrifice to do their job but also instil in their students a philosophy of service as well as gain. The teacher must be able to impress the students that salvation in regard to dwindling resources cannot be bought and to convince them that the long-time point of view is the only sound and practicable one.

It is particularly important that the laboratory worker and field biologist each understand the other's point of view and appreciate the contributions in each field. Too often there seems to be a lack of understanding and perhaps a little jealously in this matter, but each would fail without the other. At the same time it must be admitted that it is difficult to provide the students with a full understanding of the contributions of biology to conservation by laboratory and lecture without any field experience. Agassiz's statement: "If you study nature in books when you go out of doors you cannot find her!" must not be forgotten. Our urban students frequently lack any considerable outdoor background, and often the student from the farm misinterprets his observations.

Moreover, the subject must be presented logically. Biology is particularly valuable in training students to experiment, observe, note and verify the facts and synthesize them into an answer which the student himself can defend. To teach it dogmatically and teleologically may give the students bad habits of thinking which are equally obnoxious in all fields, including the solution of conservation problems. On the other hand properly presented, biology can provide both facts, and methods of problem-solving useful in conservation.

It must be emphasized that the same methods cannot be used in presenting biology at all levels. All too frequently the high school teacher apes the college instructor and so on down the line. Each pedagogue must analyze his audience and choose and present his materials accordingly. A third year student in elementary school presents an entirely different problem from a college student and to use exactly the same methods and materials on each, as has been attempted, is idiotic.

The teacher in applying biology to conservation must be courageous. It is his duty to present biological facts regardless of the pressures which may be applied on him from various angles. Vested interests will resent his instruction where it may impinge on their profits, e.g., lumber interests often fight sound programs in national parks or forests because they interfere with immediate gains. The relation between

population and food supplies and birth control are in large part biological problems, but to present accurate facts on these subjects may bring down onto the instructor's head the wrath of the clergy and others.

Again, by way of emphasis, I insist that the biologist must, wherever possible, relate his instruction to conservation and to general living. No other discipline can so readily challenge the idea so widely held that we have unlimited natural resources in the form of forests, soil, water, fish, etc. It is high time that all realize that there is not an unlimited amount of anything, not even the materials from which atomic energy is derived.

The public and public officials have a right to ask all of the above from our biologists, and the latter are obligated to do their best. On the other hand the biologists have a right to request a certain consideration from these same individuals. When decisions are to be made involving problems with biological implications, specialists should be consulted and use made of their advice. All too frequently their council is not sought on pertinent questions and their suggestions ignored even when requested. Thus we see dams being built without adequate consideration of watershed control or fish production; The Tennessee Valley Authority in some ways illustrates one of the few exceptions in this respect. Industries are encouraged without much thought being given to the replenishment of the biological resources on which they depend. Politicians foster a high birth rate without regard to the food potentials of their areas. Economically unsound loans are made by public and banking officials because they fail to assay the biological potentials of the land on which they are made. International conferences are held and important decisions made without reference to the opinions of biologists or conservationists; witness the formation of the United Nations at San Francisco without the presence of conservationists. The importance of conservation in planning for peace has been discussed by Vogt (2).

Moreover, the biologist can help give us some idea of the amount of energy we will have available from that daily stored by the process of photosynthesis. It is still doubtful that coal and oil reserves, water power and atoms can indefinitely furnish all the energy needed in our civilization. A more efficient means of capturing and making available the solar energy falling on the earth would do much toward minimizing international rivalries and the causes for war. No greater service could be performed by biology than contributing to the solution of this grave problem. That would be conservation in its highest form.

The answers may not be palatable but the biologist can provide information, and within limits, predictions concerning most problems of conservation. He can guide the lawmaker in matters of legislation concerning forests, ranges, watersheds and fisheries. He can point out to the engineers the ecological significance of his dams, roads and other devices. He can help evaluate the biological resources of an area for the economist. He can inform the sociologist as to the biological implications of many of his suggestions. He can assist the agriculturalist in the selection of efficient crops. He can legitimately propagandize the public regarding the danger of unwise exploitation of our natural resources. He can train the public to recognize the fallacy in such statements as the following: "The forest resources of the world are adequate for present

day and future needs"; "Our usuable energy resources are limitless"; "Alcohol will replace petroleum".

By way of emphasis, may I repeat that biology serving as a basis for conservation must become an integral part of the formal education of all school and college students and adults. In no other way will our citizens and officials so fully understand their environment and the need for conservation. The biologist in order to meet this responsibility, must teach with soundness, with inspiration and with breadth. He must command his subject and realize its cosmic implications. He must understand other biologists and above all his students.

With a public which fails to understand biology and ecology, our public officials, specialists and technicians will lack the support and understanding to initiate a sound attack upon the problems of conservation.

References

(1) Blose, D. T.: *Statistical Summary of Education*, 1943–44., pp. 30, 31., U. S. Govt. Printing Office, 1947.

(2) Vogt, W.: *Saturday Evening Post*, 217 (46) : 17, 109, 110., 1945.

Preserving Animals in Plastic

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Every biology teacher has at some time or another become impatient with the use of formaldehyde as a preservative for plant and animal specimens. When introducing a unit in animal classification it is very inconvenient, as well as disagreeable, to present the students with jars of "pickled" animals. Too often, the top does not fit tightly and the fluid drips out over notebooks and texts. The unpleasant odor is also a disadvantage. The students often receive their first impressions via the olfactory organ, and remember their biology periods as the "smelly" class.

Since the introduction of liquid plastic as an embedding medium this has been largely overcome. In our laboratory we have prepared specimens of the various animal phyla as permanent mounts by using plastic. This is an account of some of the work we have done. Most of the biological supply houses list plastic embedded specimens in their catalogues. These are excellent and easily obtained, but one misses the fun of doing it oneself by the purchase of them.

We used *Castolite* for our work. We selected a small animal representative of each of the phyla, with the exception of the Protozoa, for embedding. The reason for this omission is obvious.

Some of the specimens were dried, such as the starfish and cicada. Most of the others had been preserved in formaldehyde. As an example of Chordata we used a small male guppy, and in this case began our work with a living animal. The preliminary treatment of the three types was different.

The dried specimens were the easiest to work with. After selecting a suitable sized mold the embedding could be done directly. For all of our work we used small glass stender dishes. We greased these with a thin layer of vaseline and then poured each about half

full of the liquid plastic. This was allowed to harden enough to support the specimen before putting it into the mold. Then the top layer of plastic was added and the mold was put aside until the plastic hardened. We placed ours in an oven maintaining a constant temperature of 37.5° C.

The formaldehyde with which most of the specimens were saturated had to be removed before embedding, as it reacts with the plastic as it hardens and the mount is of no value. We took the animals and placed them in running water for several days. The length of time depended upon the size of the specimen. From the water they were passed through different percentages of alcohol until they reached absolute alcohol. We left them in this for forty-eight hours and then embedded them in a manner similar to that used for the dried specimens. None of them was stained with the exception of the jellyfish *Gonionemus*. This we stained with safranine before passing it through the alcohols.

We fixed the guppy in Bouin's fluid and then treated it the same as the preserved specimens.

In order to make this a permanent collection for demonstration purposes we mounted each specimen on a plastic base. The molds for these were small pill boxes. We lettered the name of the phylum and the common name of the animal with India ink on a small piece of stiff paper and embedded this in the same way we did the animals.

When all were sufficiently hardened we sanded them with varying grades of sandpaper to even the surfaces and finally polished them with a buffing machine. The final step consisted in glueing the animal mount to its respective base and this was done with a plastic glue. The accompanying pictures show three of the finished mounts.

We feel the use of plastic as a preservative has distinct advantages over formaldehyde; the specimens are easier to handle, the unpleasant odor is eliminated, the animals do not lose parts as they are passed about the class, they can be viewed from all angles, and they make a nice exhibit for the display cabinet.

At the present time we are embedding chick embryos of various ages in *Castolite*. These, too, are proving satisfactory and will be very useful.

If you decide to experiment with this type of work you will experience a great deal of satisfaction in the results. True, they are not professional mounts, but this is compensated for by the lower cost and the tremendous pleasure one derives from seeing the permanent exhibits on the shelves.

GERMICIDAL LAMPS are effective in keeping down the bacterial population in biology laboratories, but be sure to place them so that the direct rays cannot reach the eyes, for they are harmful.

An Observation Beehive

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The writer has maintained an observation beehive in his biology class room at various times during the last ten years.

At first a small observation hive was purchased from one of the bee supply companies. However, it was found to be inadequate, so it was changed from time to time. Figure 1 shows its present form which has been found to be ideal. It is in place in a window in the class room. There was a colony of bees in it at the time the photograph was taken in May, 1948.

Figure 1

Figure 2, taken the same day, shows two freshman biology students, Carol Gipe (pigtails) and Phyllis Smith (right), looking at the bees several days after a two-pound package had been put in the hive. Carol is pointing to a brood frame filled with wired wax foundation. Below it is a similar frame filled with comb which was drawn out from foundation in 1947 by another colony of bees. On a level with Carol's forehead is a beeway section holder with four sections. The colony is still small, and almost all of the bees are above in the hive body. The hive body contains eight frames similar to the one at which Carol is pointing.

Figure 2

Figure 3 shows the construction of the observation part of the hive. It consists of a framework which holds the two standard "Hoffman" frames and the section holder (not shown). The bottom frame, when in place, hangs on

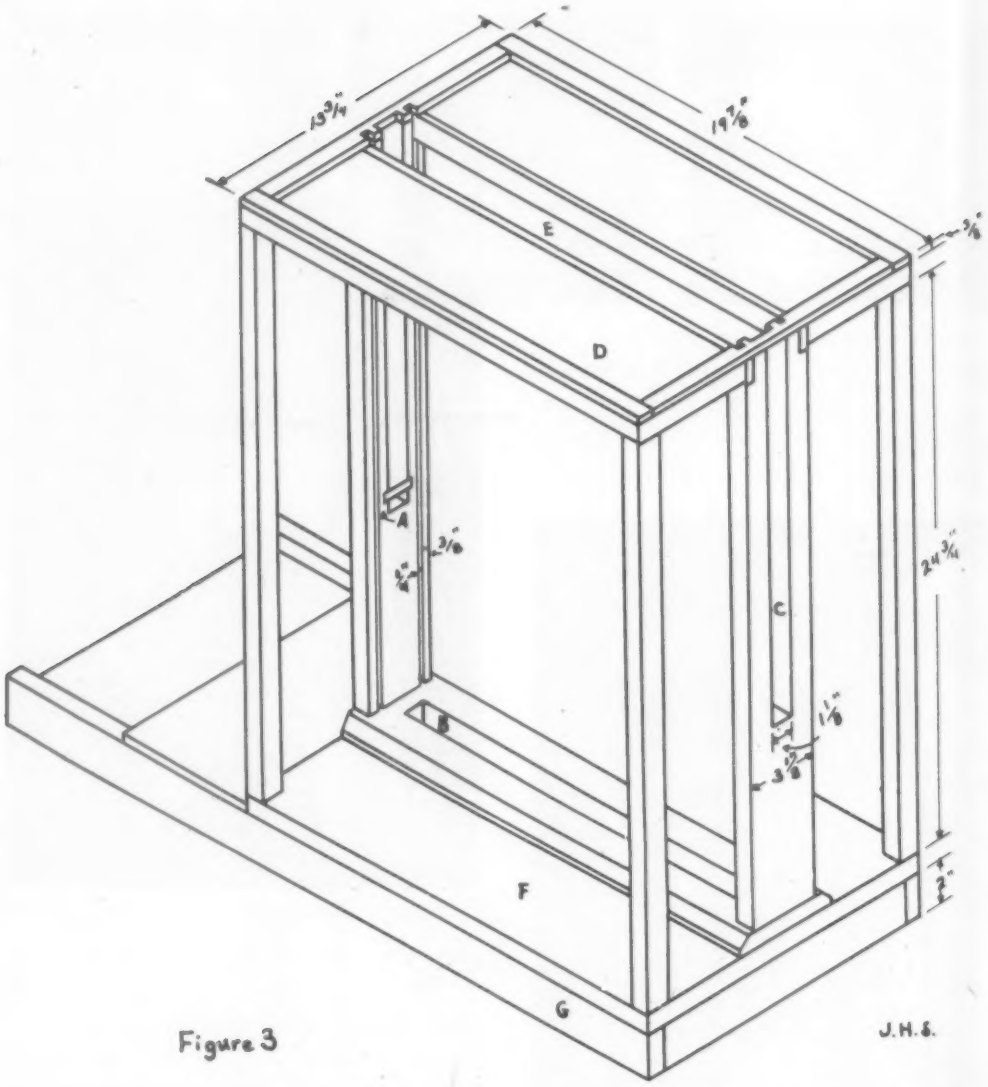

Figure 3

two small pieces of sheet metal (A) which bridge the two long, vertical slots at either end. The top edges of the two pieces of sheet metal are nine and one-eighth inches above the slotted bottom piece (B). The slots in the end pieces (C) are sixteen and three-eighths inches from top to bottom. There is another pair of sheet metal pieces (not shown) farther up which hold the other frame. The sides are three-sixteenths-inch plate glass covered with three-eighths-inch plywood. The space between the plate glass sides is two inches wide inside. The glasses slide in from the top in saw kerfs. The plywood covers may be removed for observation. The slotted ends have long, vertical doors (not shown) which cover the slots. These doors are opened to manipulate the frames. On top of the observation part of the hive is a three-fourths-inch plywood platform (D) on which eight-frame hive bodies or section supers may be placed. The platform has a long slot (E) to admit the frames and sec-

tion holder and also to permit the bees to go up and down. Around the edge of the platform is a three-eighths-inch strip which gives the bees a bee space when a hive body or super is on top. All of the other pieces in the hive are three-fourths-inch in thickness. The bottom (F) is a piece of plywood with a long slot cut down the middle of it. This slot matches the slot in the bottom piece (B). This opening allows the bees to come up from below. The bottom (F) rests on a bottom board (G) which is like a standard bottom board except that it is longer. The whole hive is covered with a piece of glass and a standard outer cover.

The hive is placed in a window with the bottom board underneath the sash and extending to the outside so that the bees may go readily in and out. Bees live a normal life in this hive, and biology students enjoy observing their activities.

If the hive is to be used primarily for observation purposes, a two-pound package of bees may be obtained from a southern beekeeper about the first of May (in Indiana) and put into the hive by shaking them into a cardboard funnel arrangement placed on top of the hive. A section is removed from the section holder, and the queen cage hung in its place. In a few days the queen will have been released, and the cage may be removed. Frames with foundation or drawn comb are inserted in the hive prior to the introduction of the bees.

If the hive is to be maintained with the additional purpose of producing honey, the package may be introduced by placing it in a hive body on top of the platform along with three or four frames filled with foundation or drawn comb.

An alternative method of populating the hive is to take it to a local beekeeper and let him introduce a captured swarm or one of his weaker colonies.

The use of hive bodies on top of the observation part of the hive gives the bees more room and helps to prevent swarming. The bees may even store a little surplus honey in section supers placed on top of the hive bodies. However, if hive bodies are used, the queen will stay in them unless she is forced to stay below by placing a queen excluder over the top of the observation part of the hive.

It is impossible to maintain the colony during the cold months of winter. Owing to the warmth of the room, the bees will be active. When they go outside, they become chilled and are unable to return. The bees may be killed in the fall by pouring carbon bisulphide in the hive. The dead bees are then removed, and moth crystals are placed in the hive to prevent the comb being destroyed by wax moths.

During the summer of 1948 the writer kept a colony of bees in an attic window of the high school building from which he took three supers of comb honey. We awarded this honey to biology students who made the highest test grades throughout the school year.

Anyone who desires to keep an observation hive in his class room should talk with local beekeepers and read references. He should also buy a standard eight-frame hive.

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THE ANNUAL MEETING

According to all reports reaching the editor's desk the Washington meeting was a highly successful and enthusiastic one. More than a hundred persons attended each of the program sessions and many excellent papers were presented. President Ruth A. Dodge is taking the responsibility of getting as many as possible of the papers in for publication and most of the next issue will be devoted to these papers or reviews or abstracts of them.

Both the Executive Board and the Representative Assembly held lengthy meetings. Among the important actions of the former was the increasing of the dues from $2.00 to $2.50; this action had been authorized a year earlier and was merely confirmed by the Board. It was also decided to set the cost of back numbers at 35¢ each, with complete volumes to sell for $2.50, except for the 11-number Volume 9, which is to sell for $3.50. At the same time it was agreed to offer a two-year membership in the United States and Canada only, for $4.50. New members may purchase the October, November, and December issues of the preceding volume for $1.00, thus making the issues complete for the school year.

D. F. Miller and George Jeffers, the present incumbents, were reappointed to represent THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS on the Council of THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. This appointment is for a two-year term.

In all business meetings a considerable amount of time was spent in the consideration of the financial and membership problems of the Association. Many phases of both problems were discussed, but no specific actions were taken, other than matters of routine business. Detailed reports of the finances and membership will appear in *The American Biology Teacher* from time to time, as has been the case in the past. The confusion that existed last year due to the change in the fiscal year no longer exists and in the near future we shall establish regular times for the reports of both finances and membership.

No changes were made in any of the basic policies of either the Association or the journal. There was considerable discussion of the possibility of obtaining added financial support from certain industries closely related to biology and biology teaching, and the secretary was authorized to formulate a program and submit it to some of the interested firms for consideration.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946

Of *The American Biology Teacher*, published monthly October to May, inc. at Lancaster, Pennsylvania.

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher: BUSINESS PRESS, INC., Lancaster, Pennsylvania
Editor: JOHN BREUKELMAN, Emporia, Kansas
Managing Editor: IRVING C. KEENE, Brookline High School, Brookline, Massachusetts
Business Manager: *none.*

2. That the owner is:
THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are:
None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear on the books of the company; also that the said two paragraphs contain statements embracing affiants full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear on the books of the company as trustees hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

JOHN BREUKELMAN
Editor

Blood In The Kanawha

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II Kings, 4, 22. And they rose up early in the morning, and the sun shone upon the water, and the Moabites saw the water on the other side as red as blood:
23. And they said, This is blood: the kings are surely slain, and they have smitten one another: now therefore, Moab, to the spoil.
24. And when they came to the camp of Israel, the Israelites rose up and smote the Moabites———.

The above excerpt, from the Bible, seems to indicate that the Moabites might have been defeated because of their ignorance of a certain biological phenomenon that has occurred many times in many places. What they mistook for blood was probably some plant or animal having a red pigment within the organism. The organisms being phototropic (responsive to light) or heliotropic (responsive to sunlight) moved to the surface on sunny days and remained below the surface on dark days. The water therefore was red when the sun was shining and did not have a red color when it was cloudy.

This summer a similar natural phenomenon was observed on the surface of the backwater at the South-East corner of the campus of the West Virginia State College at Institute. The building of the dam across the Kanawha River at Winfield caused the river above the dam to rise and back up into a low vale on the river side of the campus. In July, 1948, the surface of the water near the banks took on a red appearance on sunny days. The red color was practically unnoticeable on cloudy days. In the early morning hours, little or no color could be seen but as the sun rose and its rays became more intense the red color appeared and deepened. Whenever there were several consecutive sunny days, a red scum formed on the surface of the water. The scum was examined microscopically and was found to contain an organism known to both botanists and zoologists as *Euglena sanguinea*. Euglena of this species are generally spindle-shaped or fusiform when extended. The posterior end is pointed, but the anterior end is slightly rounded and indented, appearing as two-lipped. The blunt end also appears to be slightly oblique. A lash-like flagellum projects from the indentation. The organism lashes the water seemingly with a spiral motion forcing the water backward and subsequently pulling the body forward. The body is from 55 to 120 microns long (a micron is 1/1000 of a millimeter) when the organism is extended. The body is very elastic and readily changes shape. When conditions become unfavorable the body contracts and becomes spherical in shape. The organisms found in the scum are generally in this condition known as the resting stage. When conditions become favorable they change into the elongated form. Inside the body is a granular, red pigment that practically obscures the internal anatomy of the organism. This coloring material is known as hematochrome. The change of shape from the spherical resting stage assumed in the dark to the elongated active stage in response to the increasing amount of light might explain the deepening intensity of the red color under a rising sun. It may be that the

resting stage sinks below the surface of the water during the dark periods and in response to the sunlight changes into the motile form and moves to the surface thus restoring the red color. The members of this genus are common in stagnant water especially where algae occur.

The natural phenomena described in this article was observed during the months of August and September, 1948.

Zoologists classify this organism as a holophytic Protozoan belonging to the Order of *Euglenoidida* and the Family of *Euglenidae*.

Botanists classify the organism as a plant belonging to the Class of *Euglenophyceae*, Order of *Euglenales* and the Family *Euglenaceae*.

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Learn A "Dae" or Two

In the scientific nomenclature of birds, mammals and insects zoologists use Latin and Greek adjectives ending in "dae" to signify groups of animals that possess certain well defined family characteristics. For example, *Felidae*, the Cat Family; *Fregatidae*, Frigate Bird Family; *Geomyidae*, the Pocket Gopher Family; etc. The "dae" words below represent families. Can you pair them with their mates, the common or popular family names in the second column? Checking results, you will add to your fund of knowledge and increase your vocabulary. If you get five correct, you are good; ten you are very good; fifteen you are excellent; twenty you are remarkable. If you get more than twenty correct you must be a zoologist or a genius.

(Answers on page 51)

Adrian C. Fox,
Lincoln, Nebraska

1. *Crocodilidae*	a. Bears
2. *Ranidae*	b. Wolves, Coyotes and Foxes
3. *Hominidae*	c. Social Wasps
4. *Antilocapridae*	d. Crickets
5. *Sciuridae*	e. American Toad
6. *Vespidae*	f. Common Frog, Bull Frog, and Wood Frog
7. *Turdidae*	g. Locust or Short-horned Grasshoppers
8. *Procyonidae*	h. Praying Mantis
9. *Phasmidae*	i. Mice and Rats
10. *Salmonidae*	j. Beavers
11. *Blattidae*	k. Hares and Rabbits
12. *Cervidae*	l. Crocodiles and Alligators, etc.
13. *Psittacidae*	m. Pronghorns (Antelopes)
14. *Ursidae*	n. Cockroaches
15. *Acrididae*	o. Salmon, Trout, etc.
16. *Bovidae*	p. Raccoons, Coatis
17. *Leporidae*	q. Squirrels, Marmots, etc.
18. *Mantidae*	r. Man
19. *Muridae*	s. Walking Sticks
20. *Phasianidae*	t. Thrushes, Bluebirds, Stonechats and Solitaries
21. *Corvidae*	u. Deer
22. *Mustelidae*	v. Parrots, Macaws, etc.
23. *Bufonidae*	w. Pheasants
24. *Gryllidae*	x. Weasels, Skunks, Otters, etc.
25. *Castoridae*	y. Crows, Jays, and Magpies
26. *Canidae*	z. Bison, Sheep, and Goats

(Editor—There are many calls for puzzles and other interest-producing devices; send in your ideas—and your comments.)

The beam of light is focused on the stage of the microscope to show a cluster of spore cases. Under the small bell jar fern spores are germinating on the surface of a nutrient solution. Drawing by Roger Prince, grade eight.

Growth and Use of Ferns from Spores

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It is enlightening for a student to see microscopically a cluster of spore cases of a fern. A leaflet that contains ripe spores recently taken from a holly fern, *Polystichum lonchitis* (L.) Roth., is placed lower surface up on the stage of a microscope. No microscope slide or water is used. With a beam of light shining on the stage of the microscope, a low power objective is focused on a cluster of spore cases (sporangia).

The fern spores within the sporangia may be compared with the pollen grains from a tassel of corn—each develops asexually; each is the beginning of the gametophyte generation; but the growth of the corn spore is parasitic on a mature plant, whereas the fern spore is autophytic in a shaded moist habitat. Tap on a fern leaf that contains ripe spores and let some of the material fall on a drop of water on a microscope slide. With the light focused on the reflecting mirror, microscopic observation will

show broken spore cases and spores.

The fern spores may be grown on the surface of Knopp's Solution.* The solution on which the spores are to be thinly scattered may be placed in a culture dish and covered with glass to prevent evaporation. The spores of the holly fern, comparatively slow in growing, will produce young ferns in about a month. With the use of a medicine dropper, these young ferns (gametophytes) may be prepared as a fresh mount and examined with the microscope—the smallest ferns the student likely will have seen. These small ferns may be used to show individual chloroplastids during the study of photosynthesis.

Fern spores may be collected in an envelope for convenient storage. When spores are grown on the moist surface of an inverted flower pot filled with sphagnum moss, it may be convenient to place the pot in the battery jar rather than to invert the jar over the pot. Knopp's Solution may be *tinted* with potassium permanganate to check the growth of algae. When the ferns have developed into small heart shaped bodies (gametophytes), they must be covered with a film of water so that the sperms can swim to the eggs. The water may be added with a medicine dropper. Following fertilization and when the new growth (sporophyte generation) has developed leaves which are about 5 cm. across, mount in water and examine the lower surface of a leaf. With a 10 X ocular and 4 mm. objective concentrate on the veins of a leaf until the cross bands are visible in the walls of the water conducting tubes. These bands are invariably present and are interesting living material for the study of structure in plants. Observe the same specimen with a lower magnification and note the numerous stomata in its epidermis. When the holly ferns are about two years old, one may transplant them into small pots of loam soil. The transplanted ferns should be covered with a beaker and kept moist until well started.

* Knopp's Solution consists of 1 g. potassium nitrate, 1 g. magnesium sulphate, 3 g. calcium nitrate, 1 g. potassium phosphate and 1000 ml. distilled water. The solution should be diluted to one half for use with ferns.

Books

SCHEER, BRADLEY T. *Comparative Physiology.* John Wiley and Sons, Inc. New York. x plus 557 pp. 1948. $6.00.

This compilation of results of experimental physiology has been organized into ten chapters in which physiological processes, evolutionary history, and ecology have been correlated so as to make a suitable text for students who have adequate backgrounds in physics, chemistry, and zoological principles. In addition to its serving as a comparative physiology text, it can serve equally well as a reference for the zoologist or physiologist who is doing research. References, as footnotes, are given for nearly every statement of fact. This book also makes an excellent reference for the high school teacher.

Fundamental physiological concepts are presented and related in chapter one. The next nine chapters treat the phyla in the following order: Protozoa; Multicellular Acoelomate Animals (Porifera, Coelenterata, Platyhelminthes, and Parasitic worms); Mollusca, Annelida, Arthropoda (Crustacea and Limulus); Arthropoda (Insecta); Echinodermata; Vertebrata (Vegetative functions); and Vertebrata (Animal functions). Nutrition, feeding, digestion, circulation, respiration, metabolism, excretion, regulation of internal environment, and neuromuscular system are discussed in this order in each chapter. Each chapter is concluded by a summary which relates comparatively the ecological, evolutionary, and the physiological developments of the group or groups discussed. The chapters on the vertebrates are not as strong as the others and contain, as would be expected, less vital comparative physiology than the others; basic physiology of the vertebrates is stressed, however.

The text is easily read and very well organized. The reader after handling the book a few minutes can quickly find where a particular principle is discussed or where a species is treated. There is an extensive table of contents a species index, and a subject index. There are 72 figures, 23 tables, and an appendix which gives the classification of animals.

CURTIS, W. C. and M. J. GUTHRIE, *Laboratory Directions in General Zoology*, 4th ed., John Wiley and Sons, Inc., New York 16. vii plus 236 pp. 85 illustrations. 1948. $2.00.

The authors have prepared a textbook guide for teaching "principles" in general zoology inductively. The guide begins with an intensive study of a familiar vertebrate, the frog, and then a study of heredity and variation. The rest of the guide treats representative animals of nine invertebrate phyla, beginning with the protozoans and concluding with the echinoderms.

The directions are presented in full detail. In the reviewer's opinion the directions are too detailed for the average and poorer students, but excellent for the better students. The authors have proceeded on the premise that students will read and follow directions; this is a dangerous assumption. The directions are well organized, clear-cut, easily read, and the illustrations are exceptionally good. If students can be induced to read and to follow the directions, this laboratory guide will prove to be a very successful-teaching aid.

The guide is concluded by a survey and classification of the animal kingdom, and with an appendix. There is neither a table of contents nor an index.

TED F. ANDREWS
State Teachers College, Emporia, Kansas

RILEY, HERBERT PARKES, *Introduction to Genetics and Cytogenetics*. John Wiley & Sons, Inc., New York City. xii + 596 pp. illus. 1948. $5.00.

This new book features in logical sequence the cytological approach to the study of genetics. The first seven chapters deal with cells, genes and chromosomes; then after a chapter on probability follow linkage, chromosome mapping and related topics. With this thorough coverage of the fundamentals the latter chapters deal with such subjects as blood groups, interaction of genes, quantitative characters, non-disjunction, polyploids sex determination, evolution and the like. In many of the chapters there is a historical development, but in general the historical approach so common in many texts is missing. Both plant and animal material is used to illustrate the points brought out; there is also a wealth of applications to human heredity. The illustrations are for the most part relatively simple; they are exceedingly well chosen and help to make a difficult subject surprisingly easy to read. The various chapters are concluded with lists of "questions and problems" which range from some relatively simple and obvious to some highly complicated. This text should be used in classes that have completed at least one course in general biology. No previous knowledge of genetics is presumed; all of the basic terms of genetics and many of those of general biology are defined as they are first presented. The book is full-bodied enough, however, to take care of the needs and interests of fairly advanced students. At the end of the book is a carefully selected list of general references and individual lists of specific references for each of the chapters. This reviewer would have preferred these lists to accompany each chapter instead of having them grouped at the end; this is of course a minor point. The author index and subject index are separate; the latter is arranged to show page references in regular type and Figures and tables in italics. This book should make a superior text for classes wishing to delve somewhat more deeply than average, and it should be available in the library wherever genetics is taught.

JOHN BREUKELMAN

ANSWERS TO PUZZLE ON PAGE 48

1–l; 2–f; 3–r; 4–m; 5–q; 6–e; 7–t; 8–p; 9–s; 10–o; 11–n; 12–u; 13–v; 14–a; 15–g; 16–z; 17–k; 18–h; 19–i; 20–w; 21–y; 22–x; 23–e; 24–d; 25–j; 26–b.

BIOLOGY LABORATORIES

FIELD TRIP TECHNIQUE: When investigating animal homes under rotten logs or stumps and stones be sure to replace these to their original position. Many thoughtless persons turn these over and leave them in a new position. It will take the small life many months to restore their living quarters after one brief visit of a thoughtless biologist.

WILD FLOWER GARDEN: Does your school have a wild flower garden? Start with some inaccessible place about the building perhaps near a bit of shade. A few violets, wood ferns, trilliums and others will be there year after year and you can add to them. It is a thing that eventually will be a show spot. Ours is kept up by M. L. Jones, an English instructor. She must be commended for her efforts.

Here it was the last week in August and summer school was out. I was ready to go on a vacation. I had occasion to use some mosquitoes. In a regular ice box dish of which I keep several in the laboratory I netted a few hundred of the larvae and put them in the dish. A rubber band held a cheese cloth over its top. Every morning I listened for the hum of the newly batched adults. A bottle of ether was opened and the open mouth held over the cloth, the heavy fumes did the trick. A pair of tweezers then lifted them off the surface of the water. The cloth was replaced for the next day. I am informed the males hatch out the first day in great numbers; the next day, the catch is mostly females, on subsequent days they are mixed males and females. Take it for what it is worth, I did not check this point.

Send in your suggestions to BIOLOGY LABORATORIES, 5061 N. St. Louis Avenue, Chicago 25, Illinois.

TED F. ANDREWS, State Teachers College, Emporia, Kansas, has been added to the staff as an associate editor. His specific duty will be that of exchange editor, which involves mainly the writing of copy for *Biological Briefs*.

NEXT MONTH—many of the papers presented at the annual meeting of NABT; coming soon—*Maintaining a Salt Water Aquarium, Yeast Experiments for High School Students, Biology—1949 Model, Social Hygiene in Family Life Education, The Audubon Nature Center,* and many other long and short articles, book reviews, briefs, etc. WE NEED articles on laboratory techniques and apparatus, extracurricular projects and activities in biology, short cuts and tricks-of-the-trade items, preferably with illustrations, photographs or drawings.

LETTERS

Dear Mr. Breukelman:

Of all the Educational magazines that I have taken, *The American Biology Teacher* has the most common sense articles that I have found. The Articles are so practical and helpful.

I have a laboratory experience that I would like to share with other Biology Teachers. It has proved very useful and interesting to the pupils that I have taught.

In studying the unit on teeth, I stress the importance of straightening crooked teeth. Since most Biology students are fourteen or fifteen years of age, they are reaching the maximum age for having the teeth straightened. If it is ever going to be done, it should be attended to immediately. I have the pupils make a study of their own teeth.

Each one is given a beaker with one-third cake of melted paraffin. (The desks and floor should be covered with old newspapers.) When the paraffin is cool take three-fourths of it and make a form of the top teeth. Take the remaining wax and make a cast of the lower set.

(Have clean small glass jars for each individual in which to mix Plaster of Paris. Jars containing Baby Foods are ideal.)

The Plaster of Paris is mixed in small amounts with cold water poured into teeth molds. Be sure to pat the Plaster of Paris down so that all the air bubbles are removed. (Spoons may be used to stir the Plaster of Paris. Wipe them off with paper. They clean very easily.) It is best if the molds

stand until the next laboratory period, so that they are completely firm.

The wax may be melted off by placing in beakers or carefully pried loose with a scalpel. Care should be taken in removing the wax.

From these molds the pupils have a set of their own teeth to look at and study for shape, form, and size of teeth as well as what should be done to improve their appearance. A dentist may be asked to come to the class to show how he makes the mold of the teeth so that he may study them and decide what is the best method of correcting the position of the teeth.

I sincerely hope that you have a very successful Year.

Sincerely yours,

VIVIAN I. PENNELL,
212 Lincoln St.,
Riverhead, New York

. . . You have an ardent disciple on the faculty at the U, Ray Gilbert, who has been reading your magazine for quite a while, and has told me many times that he thinks it is very good. So good that he has talked me into it, and if I can get the required form, I'd like to send you my subscription. Got any lying around? Incidentally, how in *&%$#" do you find time to edit this magazine and teach also?

HOWARD KNIGHT,
University of Utah,
Salt Lake City, Utah

Dear Sir:

I was much interested in the article written by Irving C. Keene: "Worth While Projects —Biology Nights" in the issue of May 1948, No. 5 Vol. 10. . . .

I am also interested in a revised or up-to-date course of study in biology in the secondary school.

Yours truly,

MARY NIXON
Monessen, Pa.

. . . I have renewed for one more year because I think it is my duty and not because I think there is anything to the magazine. Who cares about the philosophy of biology or its objectives? Just tell me how to teach it better. Of course you can't please everybody, and I wish you the best of luck for the coming year.

Sincerely yours,

(Name withheld on request)

Biological Briefs

HUCTHINSON, G. E. On Living in the Biosphere. *Scientific Monthly.* Vol. LXVII. No. 6. p. 393. December, 1948.

That within our world of natural resources natural products may be utilized in both biological and cultural life is the main theme of Hutchinson's report.

Man and his life in the biosphere are directly or indirectly associated with the cyclical process of water and nitrogen, carbon and carbon dioxide, phosphorous, and others. Other dynamics of the biosphere are acyclical and if altered by man the resulting disturbance may be permanent. Obviously, this is not true of minor alterations in cyclical processes. As the population of the world increases our available resources are dwindling. Our world wars and general social disorders accelerate the disappearance of our already diminishing resources. Our problem is to rear the future generations in the belief that constructive, complicated and difficult activities are pleasurable and contribute towards our achieving a better balanced civilization in this biosphere. Hutchinson says, ". . . it is essential that the teachers in our colleges and universities should be enthusiastic investigators in fields of scholarship or practitioners and critics in their arts."

"It ought to be possible to show that it is as much fun to repair the biosphere and the human societies with it as it is to mend the radio or the family car."

GREEN PLANT'S EVOLUTION. *Science News Letter.* Vol. 54. N. 19, p. 291, November 6, 1948.

There is considerable evidence that green plants are the climax of an evolutionary line tending towards self-sufficiency in using sunshine energy. Early plants, it is believed, could not have made use of light energy to break down water molecules, as our modern plants do. The photochemical reaction and the liberation of molecular oxygen reaction are two distinct, complex mechanisms that earlier plants probably could not have employed.

Oxygen is evolved only in green plant photosynthesis, although a kind of photosynthesis, perhaps the forerunner of modern photosynthesis, occurs in purple bacteria. Only in modern green plant photosynthesis has independence of an external supply of reducing agents been accomplished.

NIXON, W. M. Good Old Bermuda. *Soil Conservationist.* Vol. 14. No. 3. p. 51, October, 1948.

Bermuda grass was introduced into the United States from India. It has proved to be a palatable grass, high in protein, calcium, and phosphoric acid. It is used extensively in south central states to tie down eroding soil and to provide grazing for 7 to 9 months of the year. Bermuda may be started by sodding, sprigging, or by seeding, with the latter proving most rapid and economical.

HARMON, WENDELL H. Hedgerows. *American Forests.* Vol. 54. No. 10. p. 499, October, 1948.

Rows of osage orange, the natural buffers, wind breaks and post producers, that serve as wildlife cover in the great plains region of the United States, are being destroyed rapidly.

Over 100 miles of hedgerows were bulldozed out in Nebraska during 1947. Will the barbed wire fence adequately replace the hedge? It has been shown that in two southern Nebraska counties over 800 miles of mature hedgerows containing over $1,300,000 worth of posts existed in 1947. The hope is that wholesale destruction will cease, if and when a better understanding of the value of hedgerows is attained.

COLE, LAMONT C. Population Phenomena and Common Knowledge. *Scientific Monthly.* Vol. LXVII, No. 5. p. 338. November, 1948.

"Until the nonscientist can be brought to think critically and skeptically about loose statements of population problems and phenomena, there seems little hope of incorporating the potentially useful results of modern research into common knowledge", so says L. C. Cole.

The layman must reason that a species, when introduced into a new suitable environment grows rapidly at first, and then finally reaches a stable level in equilibrium with its environment. At this time death rate of the species must equal birth rate.

Responses and behavior of organisms in a population depend on the environmental characteristics, the sex heterogeneity of the species, and the reproductive capacity of the species. In man human longevity is said to have been increased. These large appearing gains in longevity come primarily through increased chance of survival in early life, not through lengthened life span.

Over exploited fish populations create problems for the fisherman, ecologist, and the conservationist. Because population phenomena are not common knowledge, it is difficult to explain to the layman why fishing is seasonal, why fishes are protected at certain times, why fishing pressure must be regulated, and why overpopulation or underpopulation may decrease the production of fish.

From the above examples it may be seen that the average man can better improve his relationships to his environment by acquiring sound knowledge concerning phenomena of biotic communities, especially population phenomena.

TED F. ANDREWS
State Teachers College, Emporia, Kansas

Research Materials

A "Research Request" published in *Turtox News* reaches more than 45,000 biologists and often locates rare and hard-to-find specimens or materials. We are glad to publish such requests without charge if the material requested is not obtainable from routine sources and is needed for research purposes.

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THE STAFF

In order that readers may know who carries the chief responsibilities in the activities of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS and *The American Biology Teacher* it is the policy of the journal to publish twice a year, in the October and February issues, a complete list of all staff members. Lists of chairmen and personnel of committees are published in connection with reports of their activities.

All these individuals are deeply interested in the improvement of both the association and the journal. They welcome suggestions from members and are ready to give assistance to anyone interested in writing items or other articles for the journal.

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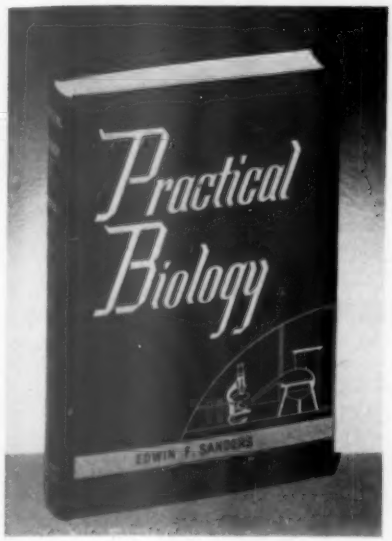

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